



**CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY,  
HYDERABAD – 500 051**

(An autonomous scientific society, under DIT, Govt.of India)

No. C-MET/HD/SP-22/Hf/CFA/

June 02, 2010

**TENDER FOR CONSULTANT FIRM APPOINTMENT**

C-MET, Hyderabad proposes to appoint consultant firm to establish pilot plant facility for preparation of Hafnium metal sponge from Zirconium raffinate. Scope of the work include designing, procurement services, commissioning of infrastructure, process equipments, utilities, safety, exhaust, ETP, etc., liaison with Govt. departments and demonstration of the production capacity.

Sealed Tenders are invited under **Two Bid System** (Part-I – Techno-commercial and Part-II – Price Bid) along with EMD for Rs.1,80,000/- in the form of DD of any Nationalized Bank drawn in favour of “C-MET, Hyderabad” from firms having expertise in refractory/reactive metals processes preferably in Zr, Hf & Ti areas.

The Tender document can be obtained either from The AO, C-MET, Hyderabad on payment of Rs.1,500/- by way of DD of any Nationalized Bank drawn in favour of ‘C-MET, Hyderabad’ **OR** may be downloaded from our website. In case tender document is downloaded from our site directly by vendor, the requisite tender fee should be submitted along with Part I bid. Tenders submitted as per the terms & conditions mentioned in the Tender Document only will be accepted. C-MET will not be responsible for postal or any other delay and reserves the right to reject any or all the tenders without assigning any reasons.

Interested bidders shall submit their details as per requirement given in page No. 2 – 10 of tender document and present technical capability on **22<sup>nd</sup> June 2010, 10.00 hrs, at C-MET, Hyderabad.**

C-MET shall present the technical details and scope of the consultancy work to the qualified bidders on **2<sup>nd</sup> July 2010, 15.00 hrs, at C-MET, Hyderabad.**

Tenders from qualified bidders completed in all respects along with relevant documents duly super scribing the name of work on envelope must reach at the following address on or before **15<sup>th</sup> July 2010 by 15.00 hours** to **The Director, CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY (C-MET), IDA Phase III, Cherlapally, HCL Post, Hyderabad 500 051.**

**ADMINISTRATIVE OFFICER**



# **Tender Document for appointment of Consultant Firm for Hafnium**

**CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY**  
(An autonomous scientific society, under DIT, Govt.of India)  
**HYDERABAD – 500 051**

## TENDER DOCUMENT FOR CONSULTANT FIRM

C-MET, Hyderabad invites separate offers from eligible Indian Consultant firms (alone or as consortium with some Indian associates) in two bid system (techno-commercial bid and price bid) for the following works:

Consultancy work to be carried out: Design, planning, installation of plant and machinery and demonstration of rated capacity of Hf plant ( <b>≈320 kg/annum Hf sponge</b> ) and relevant statutory requirement follow up & fulfillment (as per Annexure-I).	Estimated cost of the Project work to be taken up is around Rs.500.00 lakhs
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### 1. PRE-QUALIFICATION OF THE CONSULTANT FIRMS

Consultancy firm desirous of tendering for above works and fulfilling the following requirements shall be eligible (technical bid specification)

- i) Consultancy firm should have successfully completed similar works or it should have technical experts who have completed the following:
  - (a) Three similar completed works each costing not less than 40% of proposed work. (or)
  - (b) Two similar completed works each costing not less than 50% of proposed work. (or)
  - (c) One similar completed work costing not less than 80% of the proposed work.
- ii) Average annual financial turn over (from consultancy services) of the firm alongwith its associates during the last three year 2007-08, 2008-09 and 2009-10 should be at least Rs.50.00 lakhs supported with appropriate proof/certificate.
- iii) The consultant firm must be having adequate organizational setup and reasonable presence in the work area or near by and have sufficient number of experienced personnel, technical know-how, and infrastructure.
- iv) The consultant firm should have Graduates or Post Graduates in Engineering/Material Science from India or abroad. Bidder / associates should have experienced & qualified man power in varied areas of civil, mechanical, chemical and electrical engineering working with them.

- v) Prior experience in scaling up of production plant in the refractory/reactive metals processing starting from ore/raffinate to metal stage; preferably in Zr, Hf & Ti area.
- vi) They should have experience / adequate knowledge in designing, commissioning and demonstrating successfully the equipments such as slurry extraction units for metals, self resistant chlorination system, Kroll reduction system, high temperature high vacuum systems, pyrophoric metal handling systems, and effluent treatment.
- vii) They should be member of recognized professional institute.

Consultancy firm shall submit copy of self attested performance certificate.

Interested consultant firms shall submit the basic information and filled proforma 1-4 and shall make presentation regarding the technical capability on **22<sup>nd</sup> June 2010 10.00 a.m. C-MET, Hyderabad.**

C-MET shall present the technical details and scope of the consultancy work to the qualified consultancy firms on **2<sup>nd</sup> July 2010.**

The sealed techno-commercial bid and price bid should be submitted in two separate sealed envelopes super scribing “techno-commercial bid and price bid for consultancy works for installation and commissioning of plant and machinery for Hafnium production plant at C-MET, Hyderabad”.

Applications completed in all respects along with relevant documents duly super scribing the name of work on envelope must reach at the following address on or before **15<sup>th</sup> July 2010** by 1500 hours to The Director, CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY (C-MET), IDA Phase III, Cherlapally, HCL Post, Hyderabad 500 051.

C-MET reserves the right to reject any or all the applications without assigning any reasons or whatsoever.

## **2.0 INSTRUCTIONS TO THE BIDDERS FOR FURNISHING INFORMATION AS A PART OF THE BID**

Intending bidders are required to submit their bid in duplicate with full Bio data giving details about their organization, experience, technical personnel in their organization, competence, infrastructure and adequate evidence of their financial and technical standing etc in the enclosed form which will be kept confidential. While deciding upon the technical qualification of applicant great emphasis will be given on the ability and

competence of applicant to do good quality works within the specified time schedule and in close coordination with other agencies.

Only those consultancy firms who satisfy the prequalification criteria as prescribed by C-MET will be considered for final submission of technical bids.

The price bid of only those bidders will be opened who will qualify in the technical bid.

Each page of the bid shall be signed. The bid shall be signed by person (s) on behalf of the organization having necessary authorization/power of attorney to do so (certified copies to be enclosed).

If the space in the proforma is insufficient for furnishing full details, such information may be supplemented on separate sheets of paper, stating therein the part of the proforma and serial number. Separate sheets shall be used for each part. However, the format shall be as per proforma.

Any letter or document accompanying the bid shall be submitted in duplicate.

Bid containing false/incomplete and/or inadequate information are liable to be rejected. Also mere fulfillment of eligibility criteria does not guarantee selection.

Clarification if any required, may be obtained from Director, C-MET, IDA Phase III, Cherlapally, HCL Post, Hyderabad 500 051 (AP) (Tele: 040-27267309,27262437, 27265673) Fax:040-2726 1658,  
e-mail: [tlprakash@cmet.gov.in](mailto:tlprakash@cmet.gov.in)

Canvassing in any form in connection with pre-qualification is strictly prohibited and the application of such persons/organizations who resort to canvassing will be liable for rejection.

Bid, which is received after due date and time will not be entertained at all.

TECHNICAL BID

APPOINTMENT OF CONSULTANCY FIRM

Basic information

1	Name of the application/organization	
	(b) Address of the register office with phone, fax numbers and e-mail id)	
	© Address of office at Hyderabad if any with phone, fax numbers and e-mail id)	
2	Year of establishment	
3	Type of the organization (whether sole proprietorship, partnership, private ltd. or ltd. co etc)	
4	Name & qualification of the Proprietor/ partners/ Directors of the organization/firm a) b) c) (Enclose certified copies of documents as evidence)	
5	Details of registration – whether Partnership firm, company etc Name of Registering authority, date and registration number (enclose certified copies of documents as evidence)	
6	Whether registered with Government/Semi-Government/Municipal authorities of any other Public organization and if so, in which class and since when? (enclose certified copies of documents as evidence)	
7	Details of registration with 1. Institution of Engineers (enclose certified copies of documents as evidence) 2. Whether ISO certified	
8	Number of years of experience in the field and details of work in any other field	
9	Address of office through which the proposed work of C-MET will be handled and the name & designation of professional in charge	
10	Yearly turnover (consultancy amount received) of the organization during last 3 years (year wise) with satisfactory proof for receipt	2007-08 2008-09 2009-10

11	Name and address of the Bankers	
12	Enclose copies of latest return of income tax submitted to ITO	
13	PAN Number	
14	Details of registration for payment of Service Tax Service Tax No	
15	Furnish the names of 3 persons alongwith their designation, address, tele and fax etc for whose organization, you have completed the above mentioned jobs and who will be in a position to certify about the performance of your organization or contribution of technical experts.	
16	Whether any civil suit/litigation arised in contracts executed/being executed during the last 10 years. If yes, please furnish the name of the project, employer, nature of work, contract value, work order and brief details of litigation. Give name of court, place and status of pending litigation	
17	Information relating to whether any litigation is pending before any arbitrator for adjudication of any litigation or else any litigation was disposed off during the last 10 years by an arbitrator. If so, the details of such litigation are required to be submitted	

Note: Attach extra sheets with S No if the space found less.

Signature and seal of the company

Date:

## Proforma 1

- a) List of similar projects executed by the organization during the last 3 years costing Rs.50.00 lakhs and above only.

S No	Name of the work/Project with address	Name & full postal address of the owner. Specify whether Govt. under taking alongwith name, address and contact Nos of -2 persons (Engineers or top officials of the organization)	Contract amount in Rs for consultancy work only with copy of work order and completion certificate from Project in charge	Stipulated time for completion	Actual date and time for completion of Project in years	Any other relevant information. Actual amount of Project. If increased given reasons	Enclose clients certificate for satisfactory completion	Remarks
1	2	3	4	5	6	7	8	9

### Notes:

1. Information has to be filled up specifically in this format. Please do not write remark “ as indicated in brochure”.
2. Date shall be reckoned from the date of advertisement of the notice in news papers
3. For certificates, the issuing authority shall not be less than an Executive in charge.

Signature and seal of the company

## PROFORMA 2

List of important works in hand (on going) costing Rs.50.00 lakhs and above of Project cost

S No	Name of the work/Project with address	Name & full postal address of the owner. Specify whether Govt. under taking alongwith name, address and contact Nos of -2 persons (Engineers or top officials of the organization)	Contract amount with copy of work order from Project in charge	Stipulated time of completion (Years)	Present status of the Project	Any other relevant information)
1						
2						
3						

Notes: Information has to be filled up specifically in this format. Please do not write remark “ as indicated in the company brochure”.

Date and place

Signature & seal of the company

PROFORMA 3

S No	Particulars	Name and designation	Age	Qualification	Experience	Nature of works handled	Name of the Projects handled with amount	Date from which employed in the organization	Indicate details of experience for similar projects
1	Details of in house qualified civil structural Engineers								
2	Details of in house qualified Mechanical Engineers								
3	Details of in house qualified Electrical Engineers								
4	Details of in house qualified Chemical & Metallurgical Engineers								
5	Details of in house qualified Electronic Engineers								

## PROFORMA 4

### Details of infrastructure in office

S No	Items	No	Details
1	Office premises, area etc		
2	Fax Machine		
3	Telephones		
4	Other instruments		
5	Software used for planning		
6	Subscription to magazines		
7	Any other information		
8	Software for design & engineering		
9	Software for isometric piping		

Date and place

Signature and seal of the company

### 3.0 TECHNICAL DETAILS OF Hf SPONGE PRODUCTION PLANT

**Introduction of the Project:** Hafnium is a refractory metal having limited supply and high cost. It is always associated with zirconium and hence is recovered as by-product from zirconium ore. Due to its close properties resemblance with zirconium, extraction and recovery of hafnium is a tricky process. Hafnium is separated from zirconium and other impurities using a series of solvent extraction processes. Hafnium hydroxide, thus obtained, is converted to hafnium oxide. Subsequently the hafnium oxide is converted to chloride, which is then reduced with liquid magnesium to get hafnium sponge. C-MET Hyderabad has optimized process parameters in pilot plant operations. Process flow sheet is enclosed as Annexure 1. Process methodology enclosed as Annexure 2. List of process equipments and facilities required for the project is enclosed as Annexure 3.

It is planned to scale up the present pilot plant scale operations to achieve a target of 320kg/annum and hence the present work is taken up.

**Objective & scope of the project:** The prime objective of this project is to establish the plant facilities for the preparation of hafnium metal sponge starting from zirconium raffinate comprising mainly the following activities:

- A] Finalizing the specifications of process equipment based on process inputs and procurement of the same.
- B] Erection & commissioning of these process equipment including infrastructure and building.
- C] Process optimization and demonstration trials of three consecutive batches with final product meeting all the required specifications. (Product specifications enclosed in Annexure - 4 ).
- D] Demonstration of production capacity (320 kg/annum hafnium sponge)

The proposed project (with **capacity to produce 320 kg hafnium sponge / annum**) will include establishment of required civil and electrical infrastructure like detailed plant layout; for different process plants; electrical installations, cablings, transformer; piping for utilities like water, gases, air, scrubber and exhaust systems; drainage system; effluent treatment facilities; safety systems for prevention and control of fire and chemical hazards; etc.

### 4.0 SCOPE OF WORK FOR THE CONSULTANT FIRM

The broad scope of the consultant firm is to plan and design process plant facilities to produce 320kg hafnium per annum based on the process parameters optimized by C-MET Hyderabad during pilot plant studies. Scope of the consultant include comprehensive consultancy in civil, mechanical, chemical and electrical aspects of the project.

## 4.1 BIDDER'S SCOPE OF SERVICES

The scope of services envisaged under the contract are broadly categorized as below:

- Detailed Engineering Services.
- Procurement services (excluding characterization equipments)
- Construction Management & Quality Control Services
- Project Management Services

### a) Detailed Engineering Services

The consultant shall carry out the preliminary and detailed engineering based on the technical requirements presented in the enclosed document. Further, the consultant shall submit the preliminary and detailed designs for review by the C-MET review teams; incorporate the review team recommendations and prepare the tender documents.

#### Scope of this phase includes:

- Preparation of specifications, design and drawings and statement of qualifications for all the civil, mechanical and instrumentation works.
- Preparation and issue of piping layout drawings.
- Preparation of process & instrumentation diagram, cable layouts, cable schedule, inputs like functional schematics logic diagrams, instrument index etc.
- Preparation / compilation of Tender inputs for all civil, mechanical and instrumentation works.
- Preparation of specification for various process equipments, utilities, and services including instrumentation envisaged in the plant but not restricted to the details as per Annexure 3.

### b) Procurement Services

#### Mechanical Equipments and Instrumentation

- Preparation of detailed specifications of all systems and submission of the same to initiate procurement action by C-MET. Bidder shall furnish list of probable suppliers for all the equipments / services and group various

works involved into different packages for ease of procurement. Bidder shall also assist C-MET in finalizing the suppliers. Wherever the vendor has to design a system / equipment, bidder shall carryout necessary design checks. The scope also involves finalization of facility-wise Bill of Quantities for the plant.

#### Civil & Electrical

- Preparation of detailed specifications & drawings of all civil works (main process building of ~1700 sq.m. will be constructed by CPWD) such as mezzanine flooring; foundations for equipments and tanks; dykes for acid and caustic lye tanks etc. and submission in the form of purchase request to initiate procurement action by C-MET.
- Preparation of detailed specifications of all electrical systems and submission in the form of purchase request to initiate procurement action by C-MET.

Preparation of bill of materials for the erection of the plant and submission to C-MET for tendering. Preparation of final contract documents for various contracts as per the different packages (erection contract will be finalized with qualified vendor based on the inputs given by the bidder).

Review of vendor or contractor's drawings for manufacturing / fabrication / construction and approval of the same for further execution.

#### **c) Construction Management & Quality Control Services**

##### Equipments, civil and electrical

After the placement of orders for the procurement of items the bidder shall carry out stage inspections and final inspections at the premises of various parties for the timely delivery of the items.

Bidder shall also supervise the installation and commissioning of various equipments at site by the suppliers and demonstrate the process to the desired specifications.

##### Quality Assurance Plan

- Bidder shall submit the Quality Assurance Plan and inspection procedures for all the equipments that are envisaged in the scope of the work.
- Bidder shall provide sufficient and necessary documentation required for the realization of the above works. This should include all details like design calculations, P & I diagrams, Test & acceptances Procedures, commissioning plans, etc.

- Bidder shall ultimately provide project completion documents viz., drawings, operating instructions and maintenance manuals by various vendors and maintenance schedules for equipments.

**d) Project Management Services**

- Project Management Services including coordination, scheduling, monitoring and controlling of all activities and progress reporting for the scope of works.

Detailed scope of work in general is brought out in section 5.0. (This is not intended to be exhaustive and complete. Any further modification in this document shall be taken care by the bidder as required, as per the scope of work of this contract.)

**4.2 RESPONSIBILITIES OF C-MET**

C-MET shall give a presentation to the bidders describing the process and the scope of the work.

C-MET shall provide all technical details and pilot plant results to the consultant firm once it is selected, and shall demonstrate the process at lab level, if required.

C-MET will realize the civil works including building, roads and overhead tank through CPWD.

C-MET will take care of realization of characterization equipment

C-MET will initiate procurement action for various packages with detailed tender specifications / documents provided by consultant and place orders.

List of inputs given by C-MET

- |    |                                      |              |
|----|--------------------------------------|--------------|
| 1. | Process flow sheet                   | - Annexure 1 |
| 2. | Brief Description of the process     | - Annexure 2 |
| 3. | List of equipments                   | - Annexure 3 |
| 4. | Product specifications               | - Annexure 4 |
| 5. | Proposed hafnium building layout     | - Annexure 5 |
| 6. | Block diagram for hafnium production | - Annexure 6 |

**4.3 CONFIGURATION CONTROL**

During the course of the realization of the project, revisions to the design documents, fabrication, layout and isometric drawings are anticipated. It is essential that

the changes are communicated to the concerned on real time basis to enable them to fabricate / erect the systems as per the revised drawings. The following configuration control procedure shall be implemented for the smooth flow of the work.

- All changes in the drawings / documents shall be authorized by C-MET in writing.
- The drawings / documents shall bear the revision number along with the main number for easy identification.
- Revision numbers shall also be incorporated in all locations / views in the drawings for quick identification of changes.
- Copies of revised drawings shall be issued to all concerned as per the register withdrawing the old drawings simultaneously.
- All drawings released for fabrication / erection shall bear “released for fabrication / erection” as applicable with a stamp on it at a permanent location.

#### **4.4 SCHEDULES**

Bidder shall review the following schedule and confirm the same in his offer with alteration, if any, based on the feasibility of realization by the reputed / qualified contractors.

Submission of detailed specifications  
of all equipments for Preliminary Design Review (PDR) - T + 1 month

Submission of specifications & drawings  
of infrastructure for approval - T + 2½ months

Incorporation of PDR points and  
submission of documents for Critical Design Review (CDR) - T + 2½ months

Submission of equipment layout, piping  
layout diagrams in various facilities and all  
other inputs and detailed Engg. documents - T + 3 months

Submission of tender documents for  
various systems - Starts from T + 2½ months  
and progressively  
completed by T + 3½ months

The bidder will be informed at a later date in mutual consultation the number of packages for the purpose of tendering and realization.

Bidder can indicate schedule for any activities further beyond.

**Note :** Any change in the schedules will be informed to the bidder during presentation before submission of the bid.

#### **4.5 PAYMENT TERMS & CONDITIONS**

The lump sum price must be quoted for the complete scope of work except for the equipment inspection at the premises of various parties located outside the Hyderabad area (GHMC).

The price must be quoted for inspection of equipment per man-day basis excluding travel and accommodation costs. The travel and accommodation cost will be reimbursed as per bidder eligibility norms or restricted to II AC train fare for travel and accommodation as per C-MET norms. The man-days are counted excluding the travel time. C-MET will utilize such services on the need basis.

##### **Payment Terms:**

The following payment schedule is proposed

1. Advance along with release of work order against Bank Guarantee – 10 %
2. Preliminary Drawings preparation for equipments and approval by C-MET (PDR) – 5 %
3. Finalization of equipment layout, infrastructure drawings, structural drawings including approval of drawings – 5%
4. Detailed design report – 10%
5. Specification finalization of equipment and utilities including approval of drawings – 5%
6. Inspection of equipments – 25%
7. Erection & commissioning of systems including 3 trial runs demonstration – 30%
8. Final payment against Performance Bank Guarantee / after 1 year of trial runs demonstration and project team's satisfactory report – 10 %

Income tax rates will be applied as per the provisions of IT Act

#### **4.6 GENERAL TERMS & CONDITIONS**

To perform any additional work beyond the scope defined, bidder may submit man day charges for appropriate categories of personnel involved to be paid extra.

Bidder shall review the tentative schedule given and may confirm or update the same and submit along with the offer.

**Price Bid - format**

Sl. No.	Description of the activity	Quantity	Charges (Rs. )	Approx. man months planned for deployment
1	Services for basic engineering, design, preparation of tender documents, support for test & acceptance phase and site supervision for erection, mechanical commissioning of equipments etc. Demonstration of the process.	Lump sum		
2	Call charges per man day for stage inspection of procurement items outside Hyderabad			

## **5.0 DETAILED DESCRIPTION OF THE SCOPE OF WORK OF THE BIDDER**

The scope of work should in general cover the various phases of activities listed in this section and reviews will be conducted by the concerned teams at appropriate times.

The bidder shall present the concepts and configurations worked out by them to the Technical Review Committee (TRC) and other Expert teams constituted by C-MET Hyderabad and get it vetted by them. Any suggestions / modifications from review committees shall be incorporated. Number of revisions may be called for in case bidder comes out with different options in meeting the requirements of C-MET which shall be adhered by bidder.

Project proposes to have concept / configuration review, preliminary design review and detailed design / final design review. All the major interfaces with different disciplines shall be sorted out at concept / configuration review. During preliminary design phase, all the quantities / detailed specifications of all equipment, construction philosophy / realisation Techniques, erection etc., shall be addressed. Design of various systems should be in accordance with local governing codes/standards, regulations etc.

The bidder shall prepare all necessary documents for various stages like CDR, PDR, Final design Review, Quality Assurance Plan, erection plans and commissioning documents. They should also prepare tender documents for tendering action. All these documents wherever required shall be presented to the respective review teams by the bidder.

Preparation of drawings and documents for submission to Local authority/ competent authorities for required approvals and no objection certificates from Govt authorities, commencement certificate, supervision of execution of works, maintenance of record/registers, compliance of administrative/statutory guidelines for construction of building and erection of plant/equipment.

Submitting a proper PERT chart / bar chart incorporating all the activities required for the completion of the project well in time i.e. preparation of working drawings, structural drawings, detailed drawings and tender etc. The programme should also include various stages of services to be done by the contractors (finalized by C-MET for erection of various systems) in co-ordination with (and as per recommendations of) the Consultancy firm.

The bidder will have to give commitment for total responsibility for commissioning of the systems and demonstration to achieve target specification at committed scale of operation to meet annual target.

**The scope of the contract is divided into following phases.**

Design and Engineering	-	Phase – I
Procurement Services	-	Phase – II
Construction management and Quality control services	-	Phase – III
Project Management services	-	Phase – IV

## **5.1 PHASE – I: DESIGN AND ENGINEERING**

This phase has two parts, Part – I is conceptual and preliminary Design and second part is detailed design and Engineering

### **5.1.1 PART – I: CONCEPTUAL AND PRELIMINARY DESIGN**

Part – I commences immediately after the date of signing of contract. In this part, the bidders shall present the concept and preliminary design of all the systems, sub-systems therein including infrastructure. This part of work is divided into two sub parts. The first sub part being the conceptual design followed by second sub part, the preliminary design. In the first sub part, all the options which are having direct influence on the finalization of configuration, if any, shall be studied in detail and proceed on the meritorious one, for which preliminary design can be taken up. The preliminary design part ends with the successful completion of Preliminary Design Review (PDR) by C-MET and incorporation of Review Committee recommendations.

Changes / modifications / improvements over the technical inputs, if any, at this stage are to be presented to C-MET with full justification and approval obtained for such changes.

The bidder shall prepare the following details during Part – I and submit the document for review by the purchaser.

#### **a) CONCEPTUAL DESIGN**

- ❖ Schematic diagrams giving all systems, equipment & their inter connections, salient features, functions, objective etc.
- ❖ Finalisation of foundations for equipments, mezzanine floors, dykes and pipe pedestals based on pipeline / routing.
- ❖ Finalisation of equipment layout with reasonable technical specifications of equipment. Raw material flow from storage to finished condition handling

requirements, material flow sheets, sizes of structural items for platform, bought out items

**The configuration document shall contain the following:**

- ❖ Title
- ❖ User's requirement
- ❖ Layout of systems, equipments / identification of utility areas etc.
- ❖ Trade off studies on configuration giving merits and demerits and comparison of configurations
- ❖ Preliminary specifications of major subsystems
- ❖ Details of long lead items
- ❖ Configuration management plan
- ❖ Erection and transportation aspects
- ❖ Compliance / deviations to user specification

The Design Review Team will review the configuration of the items / subsystems. Any suggestion / modifications recommended by Review team shall be incorporated in the final configuration studies report.

**b) PRELIMINARY DESIGN**

The Bidder shall carryout preliminary design of systems/ subsystems / infrastructure after the conceptual design was approved by C-MET and bring out design report along with the interface detail for the items covered in the scope or for items related to other systems associated. The salient features covered under this phase of design is to be brought out major facility wise. The bidder shall consider all the features but not limited to as specified by C-MET.

The design drawings shall be prepared using Auto cad R-2002 or later versions using solid modeling.

Mechanical drawings in preliminary design stage shall show line diagrams of mechanical assemblies with specifications.

Designs carried out shall follow the respective Indian Standards which cover codes and practices for design, fabrication, inspection, testing, erection and commissioning areas. Bought out items conforming to IS codes shall be used.

**The PDR document shall contain the following for each system / sub-system**

- ❖ Background information
- ❖ C-MET requirements
- ❖ Configuration studies
- ❖ Review committee suggestion
- ❖ Design inputs / specifications
- ❖ Design criteria
- ❖ Conversion of finalized schematic diagram into a process & instrument diagram, consisting of all equipment, flow components, instruments etc. and inter connecting pipeline.
- ❖ Sizing of all pipelines based on pressure drop calculations and piping design.
- ❖ Material selection criteria in view of the process requirements
- ❖ Procurement specifications of all equipment, flow components instruments etc.
- ❖ Schematic diagrams
- ❖ Reliability and Quality Assurance Plan
- ❖ Inspection and testing procedures and scope of inspection of third party inspection agency for all systems
- ❖ Interface details between items / sub system / system
- ❖ Compliance of design specifications
- ❖ Fabrication criticalities
- ❖ Erection sequence
- ❖ Method of Testing the systems for its specifications
- ❖ Detailed specification of controllers, I/O units and operator programming station.
- ❖ Redundancy requirements met at controllers, I/O units and at net work level including the power supplies.
- ❖ Actual hardware and I/O requirements based on process requirements & their distribution with adequate spares.
- ❖ Schematic diagram of instrumentation plan and systems.
- ❖ **Finalization of inter face drawings for all the systems with respect to civil, electrical and environmental including providing details on mezzanine floors, embedment foundations, packets, grouting requirements etc. verification and adequacy of implementation of these interfaces in civil, electrical works at appropriate time.**

PDR document comprising of all the above shall be submitted for review and approval. Upon completion of PDR, and incorporation of all recommendations therein, the documentation shall be submitted to C-MET.

General: Piping & layout drawings to be prepared for entire plant. Scope of work includes preparation of

1. 2D equipment layout
2. 2D equipment support drawing
3. Piping layout in 2D
4. Piping support detailed drawing in 2D
5. Piping isometric, power to instruments cable schedule & layout, earthing
6. Bill of material for pipes, pipe fittings & pipe support
7. Engineering flow sheet
8. Process and Instrumentation Diagram

### **5.1.2 PART – II: DETAILED DESIGN AND ENGINEERING**

Part – II commences immediately after the completion of Preliminary Design Review. In this phase, the bidder shall present design / development details of the infrastructure, systems, sub-systems, major equipments including all external and internal interfaces, specific handling procedures during installation, and special fixtures, if any, shall also be identified.

The construction / installation / erection sequences is frozen in this phase. Bill of materials and services required for erection is also to be finalized.

The Part – II ends with the successful completion of the final design review by C-MET and incorporation of the Review Committee recommendations. The bidder shall prepare the following details and submit the documents finally for review by C-MET.

For machined components the design drawing shall indicate clearly the dimensional tolerance, geometrical tolerances, heat treatment / stress relieving requirements, surface finishes to be achieved, surface protection by applying anti corrosive varnish etc.

Assembly Tolerances for control assembly / Total assembly alignment accuracies, Trial run specification, performance under load specification, Type Test of items shall be worked out. The above points shall be worked out for each and every item and a final design report shall be brought out with the following for each item.

- ❖ Background information
- ❖ Review committee suggestions

- ❖ Compliance of review committee suggestion
- ❖ Finer analysis details of stress, Thermal and FMECA etc.
- ❖ HAZOP studies and implementation of recommendations
- ❖ Unresolved specification requirements
- ❖ Design of equipment foundations, RCC pedestal, cable trench etc. based on dead load and live load cyclonic load, vibration load, acoustic load etc. wherever applicable

Additional works as suggested by Design Review Committee shall be carried out by the bidder.

The applicable IS standards codes regulations for design, construction, fabrication, erection & testing shall be followed. In case any particular aspect of the work is not specifically covered by any Indian standard, International standards or any other standard practice may be followed after obtaining approval from Purchaser.

## **5.2 PHASE – II: PROCUREMENT SERVICES**

At this stage the procurement action shall be commenced for all equipment and the bidder shall provide all necessary documents / inputs to C-MET to take procurement action to realize the items.

- ❖ Preparation of list of vendors for assessment of vendor's capabilities, C-MET may participate whenever it is desired. C-MET shall approve vendor's list before final selection is made.
- ❖ Preparation of tender documents along with detailed specifications & quality assurance plan.
- ❖ Preparation of tender document for erection contract for different systems
- ❖ Review of Design / fabrication / production drawings & documents of vendors at different stages & recommending for approval by C-MET .
- ❖ Providing clarifications necessary by the suppliers to enable procurement of all equipment as per desired specifications.
- ❖ Operation procedures and schedules of various equipment, sub-systems for the desired end specification.
- ❖ Instruction, operation & maintenance manuals.

- ❖ Inspection of bought out items at vendor's premises by bidder if so desired by C-MET as per quality assurance plan.
- ❖ Acceptance test reports of all bought out items.
- ❖ Final as built drawings.
- ❖ Recommendation regarding spare parts for two years trouble free service.

### **5.3 PHASE-III: CONSTRUCTION, MANAGEMENT AND QUALITY CONTROL SERVICES**

The scope of work under this phase is mainly construction / erection / site fabrication covers the following in general.

- ❖ Preparation of detailed erection schedule & procedures.
- ❖ Co-ordination with erection contractor to meet the erection schedule

Participation in

- ❖ Inspection of the erection works to ensure completion of project in conformity with plans, specification & standard etc.
- ❖ Preparation of list of tools and construction equipment, tools, tackles, material handling equipment and inspections tools wherever necessary.
- ❖ Interfacing of instrumentation and control systems.
- ❖ Erection of all equipments, and infrastructure including electrical, effluent treatment, storage facilities, and safety systems as specified by the respective equipment supplier, following all the alignment specifications for idle run, to ensure erection is completed properly.
- ❖ Measurement and certification for release of payments.
- ❖ Extra work / Variation assessment and certification of estimate for recommendation of payment.

#### **Testing:**

Participation in the following tests:

- ❖ Wherever inter related equipments functioning is required those parameters shall be witnessed during testing prior to commissioning trials.

**After completion of the testing & evaluation of total systems, commissioning activities will be carried out with respect to specifications. Bidder should participate in this activity.**

#### **5.4 COMMISSIONING, PROCESS TRIALS & DEMONSTRATION**

The plant equipments after erection have to undergo testing / commissioning trials. This is to ensure that all the equipments are performing as per the set specifications individually. Different facilities shall be subsequently operated to carry out production trials. The plant is considered commissioned at the end of the blank runs.

After ensuring the T & E is completed of all individual equipments, as mentioned above the facility shall be operated for all operations to ensure design specifications are met in each stage. If need be repeat trials must be conducted for confirmation. All the facilities shall undergo set trials for the rated capacities.

Bidder shall participate in these activities and ensure the design specifications are achieved. If any modifications are needed on account of trials, correction inputs are to be generated by the bidder for implementation by C-MET.

Bidder shall involve in the demonstration of the production capacity (320kg/annum) to achieve the specifications given in Annexure 4.

#### **5.5 ACCEPTANCE**

The following documents in soft copies and three sets of hard copies for each item and for the plant as a whole are to be generated and handed over to C-MET as consultant contract closure reports.

- ❖ Configuration Design Document
- ❖ Preliminary Design Document
- ❖ Final / Critical Design Document
- ❖ Quality Assurance Plan
- ❖ Production Document / Construction Sequence Document
- ❖ Inspection Document
- ❖ Test and evaluation Document
- ❖ As Built Drawings
- ❖ Equipment / Facility Manuals
- ❖ Maintenance Manual

- ❖ Operation Manual
- ❖ Commissioning Document
- ❖ Closure Report

These documents shall be produced and presented at the appropriate time of execution of contract.

## **5.6 GENERAL**

1. Tendering details should include final product size with quality along with suggested batch size for each process step.
2. The bidder shall be responsible for formulating and implementing safety and quality plans as warranted for the plant, and take care of all statutory and labour regulations including effluent treatment and Co-ordination among different agencies. They should submit the details of documents / informations / data required from C-MET for liasoning with various statutory bodies in advance.
3. Wiring details for electrical system (including line diagram for wiring, method of routing, type of cables, IS standards followed in the design, and General Arrangement (GA) diagram of MCC panel)
4. Details of instrumentation and control cabling envisaged for data transmission and commands / inputs from field to control room and back along with GA diagram of PLC control panel.
5. Effluent treatment systems including storage tanks, filtration system, centrifuge, crystallization system, etc. to have zero discharge facility.

## **6.0 GUARANTEE CLAUSE**

- a) The bidder has to give undertaking for timely completion of different activities so as to complete the establishment of the plant within the period of 12 months. Proposed activity chart along with time frame should be submitted by the bidder which will be the yard stick for monitoring the compliance.
- b) The bidder has to guarantee functioning of the systems to indented specifications.

## **7.0 SECRECY**

The technical informations, drawings, specifications and other related documents forming part of the tender are the property of C-MET and shall not be used for any other purpose except for the submission of the offer. The technical informations, drawings, specifications, records and other documents shall not be copied,

transcribed, traced, or re-produced in any other form or otherwise in while and/or duplicated, modified, divulged and/or disclosed to third party nor used in any other form whatsoever without C-MET's consent in writing except to the extent required for the submission of offer. These technical informations, drawings, specifications, and other related documents shall be returned to C-MET with all approved copies and duplicates, if any, immediately after they have been used for the agreed purpose. The signed and duly stamped Non-disclosure undertaking is to be submitted by the bidder which can be handed over to the bidder at the appropriate time.

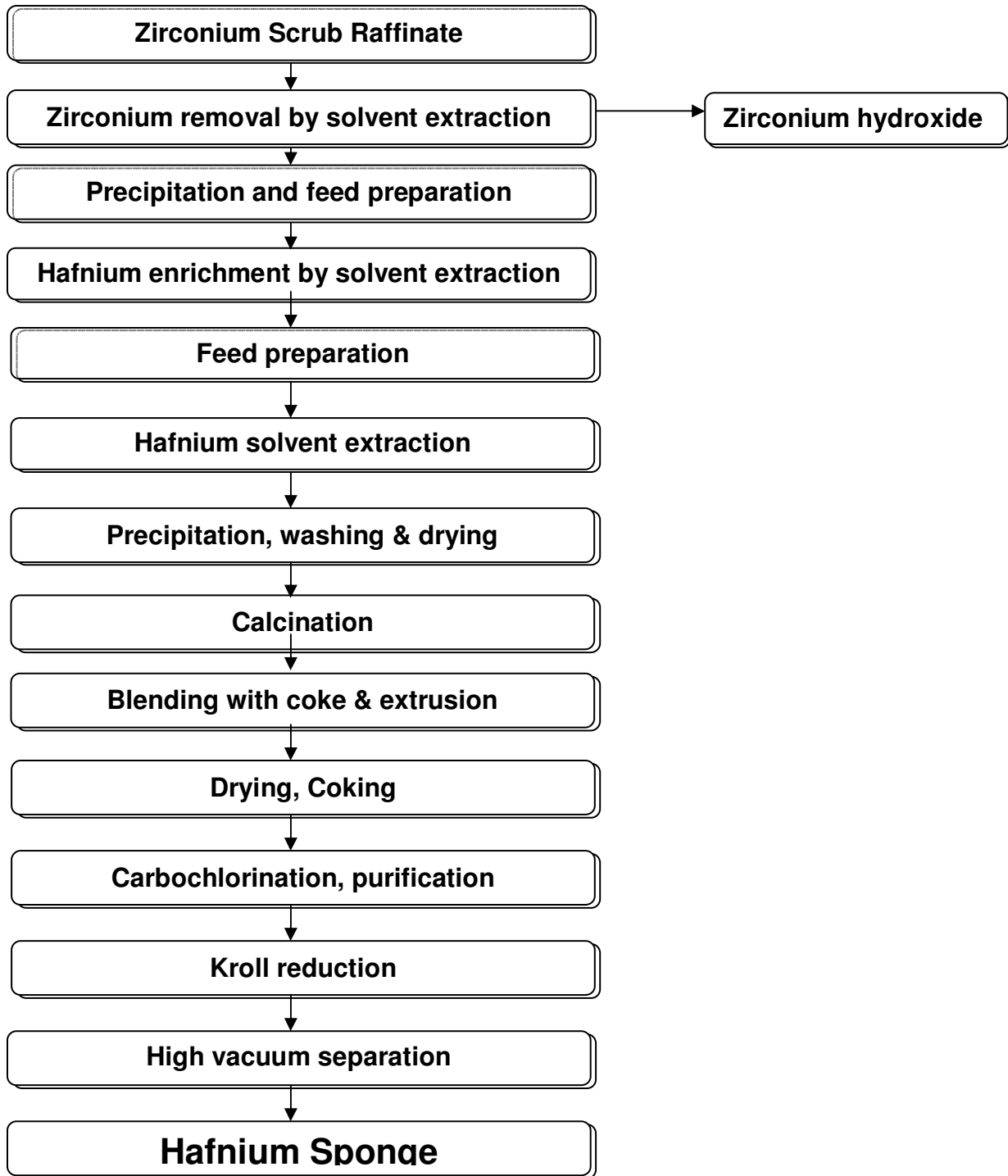
## **8.0 CHANGES AND MODIFICATIONS TO SPECIFICATIONS AND QUALITY REQUIREMENTS**

C-MET reserves the right at any time to modify the Quality requirements, specifications, etc. of the product.

C-MET may also accept by its discretion, modifications proposed by the Bidder on his own initiative.

C-MET may suggest process modifications to achieve the product specifications.

The process flow-chart is as follows:



## **PROCESS METHODOLOGY**

The proposed methodology involves the development of infrastructure facility for production plant for the preparation of 320 kg of hafnium sponge per annum, streamlining the process parameters to achieve high purity with good yield.

Zirconium clear scrub raffinate solution (having hafnium content in the range of 1-3 gpl and Hf : Zr ratio in the range of 1 : 10) shall be used as the raw material.

### **Major process steps involved are:**

1. Solvent extraction to remove zirconium
2. Precipitation & preparation of feed
3. Further enrichment of hafnium by solvent extraction of zirconium
4. Solvent extraction of hafnium and its purification
5. Preparation of hafnium hydroxide
6. Calcination of hafnium hydroxide for preparation of hafnium oxide
7. Preparation of Briquette for carbochlorination
8. Carbo-chlorination and purification of the hafnium tetrachloride
9. Kroll reduction of hafnium tetrachloride
10. Separation of magnesium and magnesium chloride from hafnium

### **Solvent Extraction to remove Zirconium**

The zirconium scrub raffinate solution, produced as the effluent after zirconium solvent extraction, will be used as the raw material. This solution generally contains hafnium in the range of (1000-3000) ppm while it has significant quantity of zirconium in the range of (10000-18000) ppm. Besides, there are other impurities like titanium, silicon, iron, etc. Zirconium is preferentially removed from the raffinate using solvent extraction process. Solvent extraction is the most critical process step in purification of hafnium. TBP diluted with kerosene is the organic used for solvent extraction of Zirconium which is preferentially extracted from nitric acid solution containing hafnium and zirconium at lower concentration of nitric acid (3 - 6 N). Most of the zirconium is removed by this process in a series of counter current solvent extraction stages. Aqueous solution left behind is enriched with hafnium along with other impurities. The zirconium loaded solvent is further treated to produce zirconium hydroxide.

### **Precipitation & preparation of feed**

Hafnium rich solution thus obtained is precipitated with sodium hydroxide, washed and filtered. The precipitate is further dissolved in nitric acid and adjusted the free acid concentration to feed normality and is used as the feed for solvent extraction.

### **Further enrichment of hafnium by solvent extraction of zirconium**

The process of solvent extraction is same as that in zirconium removal stage. This process results in enrichment of hafnium to more than 95% with respect to zirconium.

### **Solvent Extraction of Hafnium**

Hf extraction is conducted at higher normality of nitric acid solution. For this the hafnium containing aqueous solution obtained after zirconium extraction was mixed with concentrated nitric acid to increase free acidity. The solvent used for solvent extraction in this stage also is TBP diluted with kerosene which was equilibrated with high normality nitric acid. Hf is stripped by using lower acidity nitric acid solution. 99% of hafnium hydroxide is obtained after extraction and back stripping.

### **Preparation of Hafnium hydroxide**

The pure solution obtained after solvent extraction and stripping will be precipitated with ammonium hydroxide to prepare hafnium hydroxide. The hydroxide is to be washed with water to remove the soluble impurities and filtered. The filtered cake is to be dried in oven for prolonged period to remove moisture.

### **Calcination of hafnium hydroxide to Hafnium oxide**

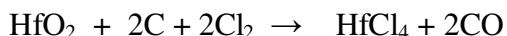
The dried hafnium hydroxide cake is calcined at 600°C - 1000°C to dehydroxylate. The resultant oxide is to be crushed and ground to get powder.

### **Preparation of Charge for Chlorination**

A reductive chlorination step has to be performed to convert hafnium oxide to hafnium chloride. Hafnium oxide is to be mixed with free carbon such as petroleum coke and binder. The paste is extruded to form briquettes. The briquettes are first heated to remove moisture and then will be heat treated under inert atmosphere to carburize the binder.

### **Carbo-chlorination and Purification of Hafnium Tetrachloride**

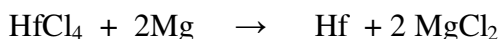
Pure hafnium chloride will be prepared from hafnium oxide in a continuous reactor. The briquettes will be fed to the reactor from the top and the chlorine gas from the bottom of a self resistance furnace with graphite electrodes and temperature increased to 700°C-1000°C. The resultant hafnium chloride collected in the condensers. The unreacted chlorine gas will be neutralized by sodium hydroxide.



Carbo-chlorination unit for continuous operation will consist of reactor, feeders, condensers and scrubber. Separate sublimation and condensation process will be conducted to further purify the hafnium chloride. In order to prevent the exposure of chlorine gas during this step the system has to be connected to dedicated exhaust through chlorine & carbon monoxide medium.

### **Kroll Reduction of Hafnium Tetrachloride**

Hafnium metal will be extracted from its chloride using the well known Kroll process in a batch process. Hafnium tetrachloride will be sublimed and reacts with liquid magnesium which is kept in a separate crucible. The reaction once started will be self sustained as the process is an exothermic one. Maintaining three heat zones at controlled temperatures in the reactor is very critical to obtain the required purity and yield.



The material of construction are selected which are compatible to both magnesium and corrosive chlorides.

### **Separation of Magnesium and Magnesium Chloride from Hafnium**

Mg reduction of hafnium chloride, results in hafnium-magnesium, magnesium chloride and magnesium in separate layers. Hafnium forms a pseudo alloy with magnesium (2-5%) and forms the lowest layer. This layer will be mechanically separated from the other layers. Magnesium and magnesium chloride associated with the hafnium will be removed by a high temperature and high vacuum operation. Magnesium chloride melts and separates from hafnium in a porous crucible kept at high temperature and magnesium evaporates at 700 -1000°C under vacuum.

The resultant hafnium sponge is crushed and blended to get a uniform feed for EB refining to prepare high purity hafnium.

### **Effluent treatment/disposal**

A large amount of liquid effluents are generated in the project due to lean nature of the starting raffinates which require pre-concentrating at different stages of processing in between the extraction process. The liquid effluents predominantly are nitrate solution in their acidic or neutral form. The total volume of these effluent generated per annum is approximately, 2000 KL of which 40% will have to be treated and recycled, 10% to be disposed off. An effluent plant has to be designed and commissioned to take care of the remaining 50% of the liquid nitrate effluents by evaporation techniques.

### Annexure 3

#### List of process equipments

Party has to design the process equipments based on production requirement (320kg/annum)

#### PROCESS EQUIPMENTS

SI No.	SYSTEM	CAPACITY	REMARKS
1	Air lift operated Mixer-Settlers for <ul style="list-style-type: none"> <li>• Zr removal</li> <li>• Scrubbing</li> <li>• Stripping</li> <li>• Solvent washing</li> </ul> Including solvent pipes, aqueous pipes, air admission pipe, air isolation valve etc.	Suitable capacity for mixer settlers has to be designed by the party based on production requirement	MOC should be compatible to Nitric acid & tributyl phosphate (TBP)
2	Ammonium hydroxide preparation plant Including sorption setup, tanks, pumps, valves, heat exchangers, cooling water facility etc.	Suitable capacities has to be designed by the party based on production requirement	MOC SS-304L
3	Filter Press for filtering zirconium hydroxide slurry – 1No.	Cake holding capacity~ 500L	MOC compatible to nitrate medium
4	Moving bed type oven for drying zirconium hydroxide with perforated supporting plate, air blower, insulation to heating chamber	Cake holding chamber ~750 litres	
5	Vent gas scrubber for solvent extraction – packed tower With centrifugal blower, suitable ducting, gauges, dampers etc.	Suitable capacities has to be designed by the party	MOC PP-FRP
6	Centrifuge (basket type) for filtering enrich hafnium hydroxide slurry	Size ~36 inches	MOC SS 304
7	Solvent extraction system for final stage enrichment of hafnium <ol style="list-style-type: none"> <li>1. Air lift operated Slurry extraction unit</li> <li>2. Air lift operated Mixer-Settlers (3 sets)</li> </ol> Including solvent pipes, aqueous pipes, air admission pipe, air isolation valve etc.	Suitable capacities has to be designed by the party	MOC should be compatible to Nitric acid & tributyl phosphate (TBP)

<b>8</b>	Solvent extraction system for hafnium solvent extraction 1. Air lift operated Slurry extraction unit 2. Air lift operated Mixer-Settlers (3 sets) Including solvent pipes, aqueous pipes, air admission pipe, air isolation valve etc.	Suitable capacities has to be designed by the party	MOC should be compatible to Nitric acid & tributyl phosphate (TBP)
<b>9</b>	Basket type centrifuge for filtering pure hafnium hydroxide slurry.	Size ~ 36 inches	MOC – SS 304
<b>10</b>	Moving bed type oven for drying zirconium hydroxide with perforated supporting plate, air blower, insulation to heating chamber	Suitable capacities has to be designed by the party	MOC – SS 304
<b>11</b>	Muffle Furnace for calcinations of hafnium hydroxide With 8 stage programmable control Operating temperature: 900°C	Suitable capacities has to be designed by the party	Muffle - SS310 Trays – SS 310L
<b>12</b>	Hammer Mill for milling hafnium oxide With air classification system, Cyclone separator and bag-house.	Suitable capacities has to be designed by the party	SS 304L hammers,
<b>13</b>	Motor operated Double Cone Blender for blending hafnium oxide for getting homogeneity	Suitable capacities has to be designed by the party	SS 304L
<b>14</b>	Sigma Mixer for mixing hafnium oxide, calcined petroleum coke and binding material starch	Suitable capacities has to be designed by the party	SS 304L
<b>15</b>	Extrusion type pug mill	Die Diameter – 15 mm Cap – Suitably designed as per process requirements	SS 304L
<b>16</b>	Tray drier Operating temp: 120°C	Approx. Cap: 60 kg briquettes	SS 304L
<b>17</b>	Coking system for briquettes 1. Furnace with Temp: ~800°C 2. Retort 3. Crucibles (3 no.)	~60 kg briquettes	SS 310S SS 430
<b>18</b>	Chlorination system Consisting of 1. Self resistance shaft furnace (~1000°C) with top charging facility, gas panel, heating lines for chloride 2. Condensers- 3Nos	Suitable capacities has to be designed by the party	MOC compatible to chlorine and chloride

	3. Scrubber and exhaust		
<b>19</b>	Retort for chloride Purification suitable for coking furnace (Sl. No. 17) with condensers	Suitable capacities has to be designed by the party	Inconel
<b>20</b>	Kroll reduction system – consisting of <ol style="list-style-type: none"> <li>1. Reduction furnace- four zones with independent controllers (programmable), electrical control panel, temp. ~900°C</li> <li>2. Reduction retort- with provision for hanging chloride can, adequate nozzles, heating facility, coolant coils, vent valves with all safety features</li> <li>3. Magnesium holding crucible with liner</li> <li>4. Chloride can</li> <li>5. Electrical panel</li> <li>6. Gas panel</li> </ol>	Suitable capacities has to be designed by the party	MOC Retort- SS310 Magnesium crucible – SS 430 Chloride can – inconel
<b>21</b>	Magnesium separation system- consisting of <ol style="list-style-type: none"> <li>1. Two zone electrical heated Furnace – operating temp. ~1000°C</li> <li>2. Retort- with ports to vacuum and gas lines</li> <li>3. Vacuum system- for achieving <math>10^{-6}</math> Torr, preferably a combination of rotary, roots and diffusion pump</li> <li>4. Electrical control</li> </ol>	Suitable capacities has to be designed by the party (gasification -3-4 % of input mass)	SS 310 cladded/explosive welded with SS430
<b>22</b>	Sponge handling system- consisting of Hydraulic press, jaw crusher, double cone blender	Suitable capacities has to be designed by the party based on production requirement	
<b>23</b>	Sponge storage facility Vacuum/controlled atmosphere glove box	Suitable capacities has to be designed by the party based on production	

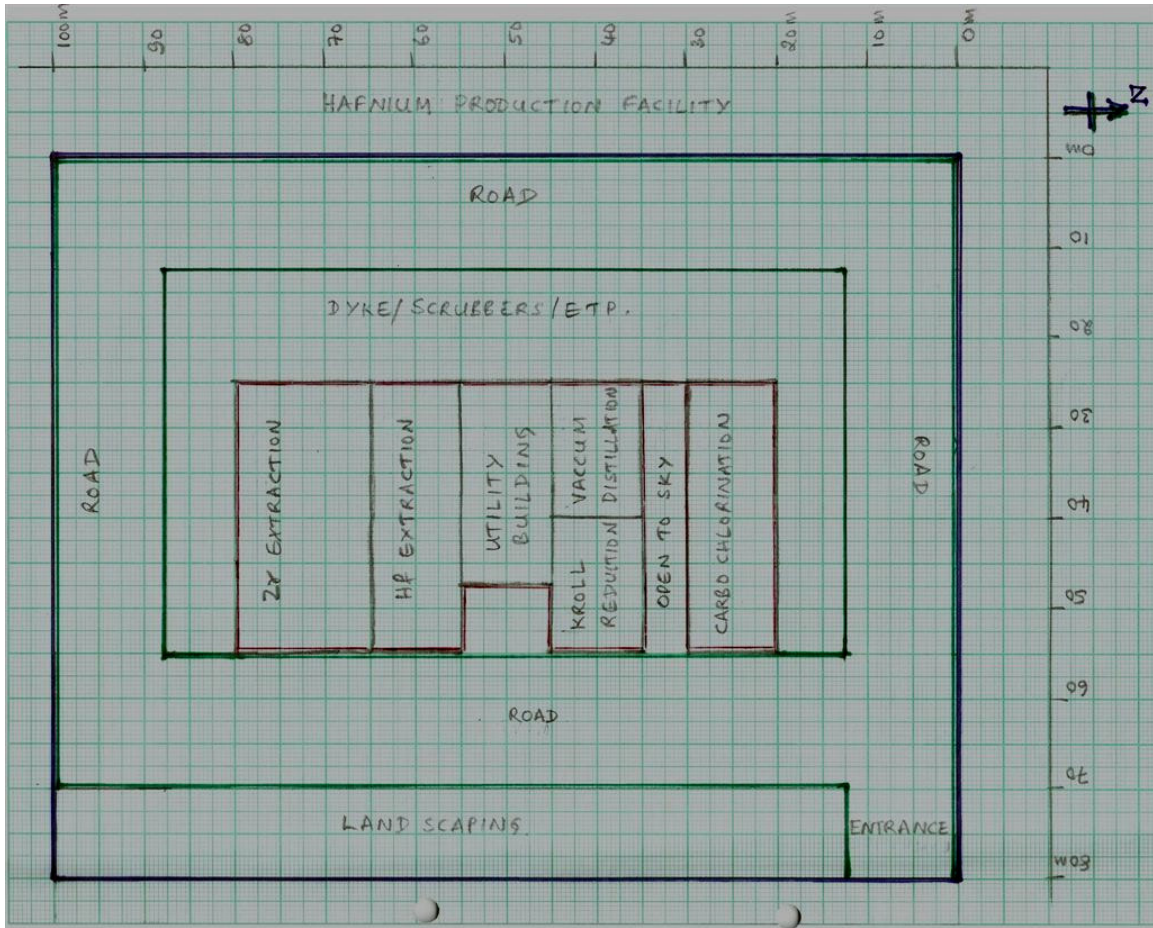
		requirement	
24	Air compressor- required for solvent extraction systems Air compressor – required for instrumentation		
25	Cooling Water System	Suitable capacities has to be designed by the party	
26	De-mineralized water plant Equipped with sand filter, cation and anion exchanger column, mixed bed, acid dosing tank, alkali dosing tank and salt dosing tank et.	Capacity: ~10000 L/hr	
27	<b>Instrumentation</b> Automation of various process streams		
28	<b>Material handling systems</b>  Battery operated forklift Cranes, hydraulic trolley, chain pulley system, E.O.T etc.		
29	<b>Piping</b> Interface between storage tanks and process area, lines for different input and output solutions, gas lines, compressed air lines, process water, cooling water etc.		
30	<b>Civil infrastructure</b> Detailed Plant lay out incl. process plants, characterization area, tanks farms, utilities, mezzanine floors, foundations, dykes etc, (brief diagram enclosed)		
31	<b>Electrical infrastructure &amp; power back up</b> Switch yard, power cable, MV panel, MCC, transformer, Plant lighting, street lighting Generator etc.	11 KV high tension line with Transformer capacity 150 KVA	
32	<b>Storage tanks for</b> 1. Water 2. acids 3. Caustic lye 4. Raffinates, effluents etc. 5. Ammonia solution	Capacities required as per the process indicated above	

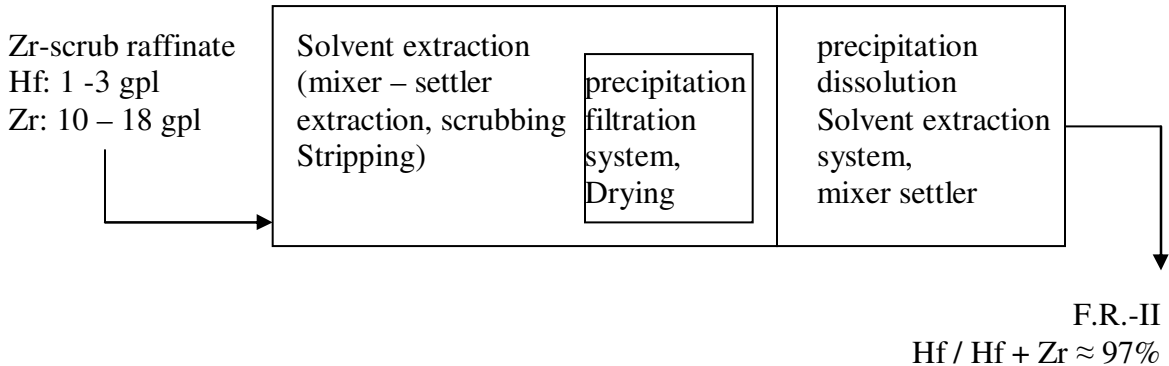
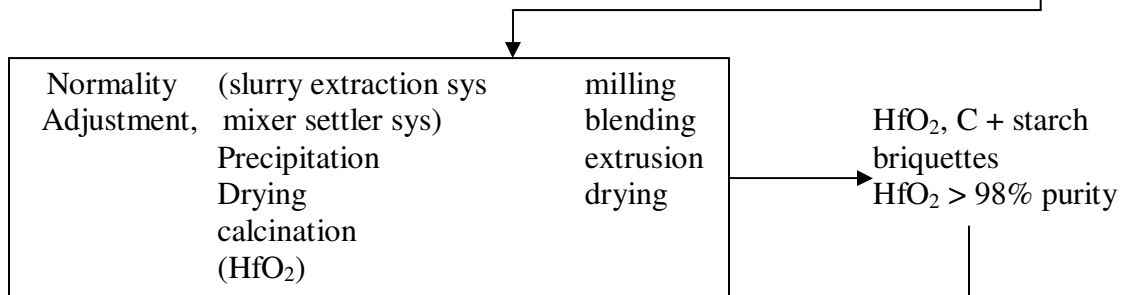
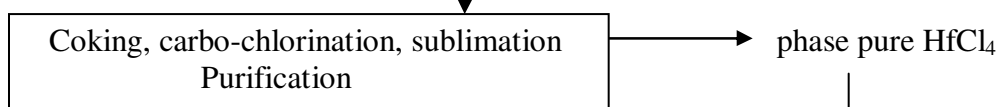
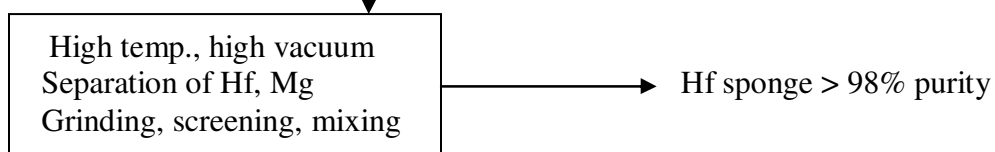
	6. Solvents 7. Kerosene 8. Zr-raffinate (Input) 9. Other chemicals		
<b>33</b>	<b>Day tanks</b> Required tanks for optimum utilization	Capacities required as per the process indicated above	
<b>34</b>	<b>Process tanks</b> Required tanks for optimum utilisation	Capacities required as per the process indicated above	
<b>35</b>	<b>Process pumps</b> a) Centrifugal pumps, b) Metering pumps	Required numbers and capacities	
<b>36</b>	<b>Safety aspects:</b> Incl. fire fighting eqpts., ventillation system, scrubbers etc. Gas sensors and monitors		
<b>37</b>	<b>Effluent treatment plant</b> Incl. neutralization, filtration and evaporation, crystallization systems for 1000kL nitrate based raffinate		

**Typical Specification of Hafnium**

<b>S.No.</b>	<b>Element</b>	<b>Concentration (in percentage)</b>
1.	Zirconium	<0.9
2	Iron	<0.3
3	Chromium	<0.05
4	Carbon	<0.05
5	Aluminium	<0.005
6	Nickel	<0.005
7	Oxygen	<0.3

# PROPOSED HAFNIUM BUILDING LAYOUT



**BLOCK DIAGRAM FOR HAFNIUM PRODUCTION**Zirconium solvent extraction plantHafnium Extraction plantCarbo-chlorination plantKroll reduction plantVacuum Distillation plant  
(Mg separation)

## Zirconium solvent extraction area

Air lift operated Mixer-Settlers  
(10 stages) for **4 sets**

- Zr removal
- Scrubbing
- Stripping
- Solvent washing

Filter Press for filtering zirconium  
hydroxide slurry **1 set**

High Temperature Oven  
for drying zirconium  
hydroxide cake **1 set**

Vent gas scrubber **1 set**

Centrifuge **1 set**

- Provision for compressed air, central exhaust, supply water, DM water, drainage, ammonia line, nitric acid line, solvent line
- Flame proof electrical wiring and fittings, three phase power supply
- Fire Safety systems, wash area, shower, toilet, basins..

Connected load : ~30kW

## Hafnium Extraction area

Air lift operated Slurry Extraction Unit	<b>1 set</b>
Air lift operated Mixer-Settlers (10 stages)	<b>3 sets</b>
<ul style="list-style-type: none"><li>• Scrubbing</li><li>• Stripping</li><li>• Solvent washing</li></ul>	
Ammonium hydroxide preparation plant	<b>1 set</b>
Centrifuge	<b>1 set</b>
High Temperature Oven	<b>1 set</b>
Muffle Furnace	<b>1 set</b>
Hammer Mill	<b>1 set</b>
Double Cone Blender	<b>1 set</b>
Mixer and Kneader	<b>1 set</b>
Extrusion Mill	<b>1 set</b>
Drier	<b>1 set</b>

- Provision for compressed air, central exhaust, supply water, DM water, drainage, ammonia line, nitric acid line, solvent line
- Flame proof electrical wiring and fittings, three phase power supply
- Fire Safety systems, wash area, shower, toilet, basins....

Connected load : ~70kW

## Carbo-chlorination area

Coking Furnace	<b>1 set</b>
Retort for Coking Furnace	<b>1 set</b>
Coking crucibles	<b>3 Nos.</b>
Chlorination Furnace	<b>1 set</b>
Condensers	<b>4 sets</b>
Retort for Purification	<b>1 set</b>

- Nitrogen/argon line, Chlorine gas line, compressed air line, water line, Eye wash station, wash area, fire safety system
- Special power line, water cooled power lines, Eye wash station
- Fire proof electrical wiring, Flame proof electrical fittings & 3 phase power supply

Connected load : ~70kW

## Kroll reduction area

Reduction Furnace	<b>1 set</b>
Reduction Retort	<b>1 set</b>
Magnesium holding Crucibles	<b>4 sets</b>
Chloride can	<b>4 Nos.</b>
Crucible Liners	<b>6 Nos.</b>
Electrical Control Panel	<b>1 set</b>
Gas Control Panel	<b>1 set</b>
Instrumentation	<b>1 set</b>
Fire Fighting Equipments	<b>1 set</b>

- Filtered air provision, Argon line, compressed air line, water, DM water line
- Flame proof electrical fittings & 3 phase power supply
- Water line, Eye wash station, wash area, fire safety system

Connected load : ~50kW

## Vacuum Distillation area

Vacuum Distillation Furnace	<b>1 set</b>
Electrical Panel	<b>1 set</b>
Vacuum Systems	<b>2 sets</b>
Sponge Handling Equipment	<b>1 set</b>
Glove box	<b>1 set</b>
Instrumentation	<b>1 set</b>
Fire Fighting Equipments	<b>1 set</b>

- Filtered air provision, Argon line, compressed air line, water, DM water line
- Flame proof electrical fittings & 3 phase power supply
- Water line, Eye wash station, wash area, fire safety system

Connected load : ~40kW

## Others

Air Compressor for process requirements	<b>1 set</b>
Air Compressor for Instrumentation	<b>1 set</b>
Vacuum Pump for filters	<b>1 set</b>
Cooling Water System	<b>1 set</b>
De-mineralized water plant	<b>1 set</b>
Emergency Power Back-up	<b>1 set</b>
MCC	<b>6 sets</b>
Fire Fighting Equipments	<b>1 set</b>
Valves and Pipe lines for all work centers	<b>1 set</b>
Electrical and Instrumentation Cabling	
Vent gas scrubber for Chlorination	<b>1 set</b>
Ventilation System for Sponge handling area	<b>1 set</b>
Material Handling system	

- Water tank : Sump capacity: 100 KL  
Overhead tank Capacity: 50 KL at 20 m height
- Storage facility with dyke for Zr scrub Raffinate, solvent, acids, ammonia, effluents, DM water, argon, nitrogen & chlorine gas  
Connected load: ~30KW

### Administration Building:

- Administrative building include store, sample preparation lab, characterization area, conference room, office, supervisor room, canteen, dispensary, electrical/instrumentation/mechanical room with vitrified tiles flooring & provision of vehicle parking

Connected load: ~50KW